Social Deprivation and Mortality in Adults with Diabetes Mellitus

N. Robinson[1]*, C.E. LLoyd[2], L.K. Stevens[3]

[1]*Centre for Sexual Health and HIV Studies, Thames Valley University, London,*
[2]*Department of Public Health and Epidemiology, University of Birmingham and*
[3]*Department of Epidemiology and Public Health, University College, London*

To investigate the relationship between measures of social deprivation and mortality in adults with diabetes, data from 2104 randomly selected adults (>16 years of age) with Type 1 and Type 2 diabetes mellitus from 8 hospital out-patient departments were analysed. A total of 38% of subjects had Type 1 (diagnosed before the age of 36 years and treated with insulin), 55% were male and 85% Caucasian. During a follow-up period (mean (SD) of 8.4 (0.9) years), 293 (14%) of the subjects died, the most commonly recorded cause of death being cardiovascular disease. Duration adjusted odds ratios (OR) and 95% confidence intervals (CI) were calculated separately for Type 1 and Type 2 subjects. The mortality rates for men were higher than for women (Type 1: OR 1.27, CI 0.61–2.62; Type 2: OR 1.79, CI 1.27–2.52); were higher for those of lower vs higher social class (Type 1: OR 1.34, CI 0.61–2.96; Type 2: OR 2.0, CI 1.41–2.85); and were higher for those who left school before 16 years of age compared to those who left school at or after 16 years of age (Type 1: OR 3.98, CI 1.96–8.06; Type 2: OR 2.86, CI 1.93–4.25). Subjects who were unemployed had a higher mortality rate than those employed at the time of the study (Type 1: OR 3.10, CI 1.67–5.79; Type 2: OR 2.88, CI 2.12–3.91) and those living in council housing had a greater mortality than those who were living in other types of housing (Type 1: OR 2.57, CI 1.35–4.91, Type 2: OR 2.76, CI 2.05–3.73). Also for both Type 1 and Type 2 subjects mortality was significantly higher in those subjects who had a least one diabetic complication at baseline and reported one or more hospital admissions in the previous year and in Type 2 subjects with poor glycaemic control. After adjusting for duration of diabetes, hospital admissions, and the presence of diabetic complications, being unemployed, male, in poor glycaemic control (Type 2 only), and less educated were significant risk factors for mortality (*p*<0.001). These results suggest that there are important indicators of social deprivation which predict mortality over and above diabetic health status itself. Locally targeted action will be required if these inequalities in health experienced by people with diabetes are to be reduced.

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Introduction

Unemployment has a major impact on both morbidity and mortality and is a key indicator of living standards and poverty.[1] Previous work has shown that unemployment is a particular problem for people with diabetes,[2,3] and in terms of health and social outcomes, this may have serious consequences.[4,5] Unemployment does not only mean loss of income but can also result in loss of social status for individuals, can affect personal attachments, and is associated with other factors such as poor diet and housing.[6]

It has also been demonstrated that unemployment is a good marker of both material and social deprivation and is highly correlated with hospital admission rates.[1] The aim of this paper was to investigate the relationship between measures of deprivation and mortality in a population of adults with diabetes in eight different geographical areas in the UK, over an 8.5–9-year follow-up period.

Subjects and Methods

Details of the study methods have been given in previous publications.[2,4] Briefly, a total of 3955 diabetic patients (insulin and non-insulin-dependent men and women of working age, 17–65 years) were randomly selected from eight diabetic clinics in different geographical locations in the UK.[2] Between March 1985 and April 1987, questionnaires requesting demographic and employment

* Correspondence to: Dr Nicola Robinson, Centre for Sexual Health and HIV Studies, Wolfson Institute of Health Sciences, Thames Valley University, 32–38 Uxbridge Road, Ealing, London W5 2BS, UK.

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information were sent to each patient. Data on patients' clinical status, including the presence and treatment of any diabetic complications and indicators of diabetic control, were collected from hospital records. Diabetic complications recorded were: the presence (according to the physician) of diabetic retinopathy; proteinuria (albustix positive on the last two consecutive clinic visits); hypertension (i.e. currently on anti-hypertensive treatment); a record of myocardial infarction, intermittent claudication, angina, cerebrovascular disease or stroke, foot ulcers or gangrene, amputation, symptoms of autonomic neuropathy (i.e. diarrhoea, gustatory sweating or postural hypotension); and evidence of peripheral neuropathy (i.e. paraesthesia, numbing, tingling, loss of sensation in the limbs, loss or absence of ankle or knee jerks on at least two visits, absence of pedal and tibial pulses on at least two visits).

Glycaemic control was measured via the standard methods available at each centre. Five centres used the Corning electroendosmosis technique (Corning, Essex, England), one used an in-house wet chemical method for automated continuous flow analysis after Fluckiger and Winterhalter, one a high performance liquid chromatography technique (Column) HPRC technique, and one the Affinity Gel method from Pierce. As various methods were used, and most had different reference ranges, it was not possible to compare HbA_1 values. Therefore, for each centre, subjects were divided into those in poor vs fair control, as indicated by the median split of the HbA_1 distribution for that centre. Analysis of glycaemic control levels in terms of poor vs fair control, was thus possible only for the total study population.

Out of 3514 valid recipients (excluding 11% of the original questionnaires returned from the Post Office as addressee unknown), 2104 questionnaires were returned giving a response rate of 60 %. Comparisons between responders and non-responders showed both groups to be similar in terms of their demographic and clinical characteristics.[4] Patients included in the initial sampling frame were selected from current clinic lists and had been seen in the clinic during the previous year. To the clinics' knowledge, few, if any patients were living in residential or nursing homes at the time of recruitment into the study. The sample was therefore likely to be representative of the working population attending the eight diabetic clinics in the UK during the time frame of the study.

The Registrar General's Classification of Occupations was used to group subjects into social class categories.[7] Classifications were based on the subjects' current occupation or most recent occupation or, in the case of housewives, their husbands' occupation, and for adolescents and students, their fathers' occupation as head of the household was used. Subjects were divided into the following social class groups: professional (I), managerial (II), skilled non-manual (IIINM), skilled manual (IIIM), partly skilled (IV), and unskilled (V).

Those patients returning their questionnaires were tagged for mortality by the Office of Population Censuses and Surveys. Patients with insulin-dependent (Type 1) diabetes were defined as those diagnosed prior to the age of 36 and being treated with insulin at the time of the survey. All other subjects were classified as non-insulin-dependent (Type 2) for the purpose of this study.

Employment was defined by self-reported employment status. The analysis classified the population into those economically active (employed or seeking employment but unemployed), and those economically inactive (retired, too ill to work, student, housewife). Unemployment in this analysis was calculated using the denominator of economically active. The numerator was based on the subject's report of their current employment status.

Statistical Analysis

To examine the difference between group means and proportions of Type 1 and Type 2 subjects, the two sample *t*-test and the chi-square test were used, respectively. In order to assess the risk of mortality associated with all risk factors, duration adjusted odds ratios were calculated, where the odds ratios were directly standardized to the distribution of duration of diabetes for the whole sample and weighted according to tertiles of the distribution. The significance of the adjusted odds ratios were tested using the extended Mantel–Haenzel chi-square.[8,9] The probability of survival over the follow-up period was compared for those with and without various indices of social deprivation using the Kaplan–Meier survival curves[10] and the Lee-Desu statistic to compare the survival experience of the different groups.[11]

In order to assess whether the social indices were predictive of mortality over and above other known risk factors for mortality, forward stepwise Cox proportional hazards modelling was performed.[12] Variables made available for inclusion in the models were those significantly related to mortality in the duration adjusted analysis, with duration being forced into the models. Since age and duration were highly correlated for both Type 1 and Type 2 subjects, the modelling was then repeated with age forced into the models instead of duration. The threshold for a variable entering the model was set at $p<0.05$. In order to compare coefficients in the models, standardized odds ratios were calculated where, for a continuous variable, this was the exponent of the product of its regression coefficient and its standard deviation. For a categorical variable it was the exponent of its regression coefficient. The statistics were analysed using the Statistical Package for the Social Sciences (SPSS^X)[13] and BMDP.[14]

Results

During a mean (SD) follow-up period of 8.4 (0.9) years, 293 (14 %) of the subjects who originally replied to the questionnaire had died. The most common underlying cause of death was cardiovascular disease (ICD codes

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390–459 or 798.1), accounting for 54 % of deaths. Diabetes-related deaths (ICD codes 250.0–251.2) accounted for 19 % of the total mortality; for a small proportion of deaths (6 %) the underlying cause was attributed to renal disease (ICD codes 250.3 or 585–590) and for 16 % of the deaths the underlying cause was recorded as cancer (ICD 140–209).

Table 1 gives the demographic characteristics of the study population. Nearly two-thirds of the sample followed up for mortality were Type 2 subjects. As expected, the mean age for Type 2 subjects was greater than for Type 1 ($p<0.0001$), and the mean duration of diabetes was shorter for Type 2 ($p<0.0001$). There was a slightly higher proportion of male subjects (55 %) than female subjects and the majority of participants were Caucasian (85 %). Compared with Type 1 participants, those with Type 2 diabetes were significantly more likely to be from social classes IIIM, IV and V ($p<0.001$). Type 2 subjects were more likely to be married ($p<0.001$) and to have left school before the age of 16 years ($p<0.001$), but there was no difference in the proportions of Type 2 and Type 1 subjects who owned their own home. Type 2 subjects were also more likely to have been unemployed at the time of the survey ($p<0.001$).

Diabetic complications, i.e. a prior history of retinopathy, proteinuria, hypertension, cardiovascular disease, cerebrovascular disease, and peripheral neuropathy were more prevalent at entry to the study in subjects with Type 2 diabetes where 39 % had at least one complication, compared with Type 1 subjects where this proportion was 27 % ($p<0.001$). The mortality rate over the 9-year follow-up period was significantly higher in Type 2 than in Type 1 subjects (10 % vs 4 %, $p<0.001$). Given these differences between Type 1 and Type 2 subjects, all further analyses were carried out separately for these two groups.

Tables 2 and 3 show the crude death rates, crude odds ratios, and duration adjusted odds ratios for mortality associated with demographic factors, social indices and employment status for Type 1 and Type 2 subjects separately. After adjusting for duration, Type 2 males had a higher mortality rate compared to Type 2 females (p=0.0008). Type 2 patients in the lower social classes had twice the mortality of those in the higher social classes (p=0.0001). Gender and social class differences were not so apparent in subjects with Type 1 diabetes. For both Type 1 and Type 2 subjects, those who left school before the age of 16 years had a significantly higher mortality rate compared to those who left at age 16+; odds ratios (OR) and 95 % confidence intervals (95 % CI) were 3.98 (1.96–8.06) and 2.86 (1.93–4.25), respectively. Those who were registered as disabled had at least twice the mortality than those who were not (Type 1: p=0.003, Type 2: $p<0.0001$). Subjects who were living in council accommodation also had a higher mortality rate compared to those living in other types of housing (i.e. owner-occupiers and those in privately rented accommodation) (Type 1: p=0.004, Type 2: $p<0.0001$). The mortality rate of those unemployed at the time of the study was approximately three times higher than those who were employed (Type 1: p=0.0003, Type 2: $p<0.0001$), and those Type 1 subjects who reported that they had been unemployed for 1 year or more had 6.8 times the mortality of those who reported that they had been unemployed for less than 1 year (p=0.001).

For both types of diabetes, those who reported that they had lost their job due to their diabetes were significantly more likely to have died during follow-up than those who had not (Type 1: p=0.05, Type 2: p=0.02). Type 1 subjects who reported having to change their job due to their condition had a higher mortality compared with those who did not (p=0.007). Whether or not subjects reported that they worked shifts was not associated with increased mortality.

Other baseline risk factors found to be significantly

Table 1. Demographic details of the study population by type of diabetes

	Total $n=2104$	Type 1 $n=798$	Type 2 $n=1306$
	Mean (SD)	Mean (SD)	Mean (SD)
Age (yr)	47.2 (9.8)	37.1 (13.0)	53.8 (8.4)[a]
Duration (yr)	12.0 (8.3)	17.5 (10.4)	8.6 (7.7)[a]
	n (%)	n (%)	n (%)
Male	1156 (55)	405 (51)	751 (58)[a]
Social class IIIM, IV, V	987 (47)	301 (38)	686 (53)[a]
Home ownership	1111 (53)	423 (53)	688 (53)[a]
Married	1476 (70)	500 (63)	976 (76)[a]
Age left school < 16 yr	1154 (55)	298 (37)	856 (66)[a]
Unemployed	881 (42)	268 (34)	613 (47)[a]
Caucasian	1794 (85)	780 (98)	1014 (78)[a]
1+ Major complication	723 (34)	219 (27)	504 (39)[a]
Died during follow-up	293 (14)	50 (6)	243 (19)[a]

[a]Significant difference in comparisons between Type 1 and Type 2 with $p<0.001$.

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Table 2. Mortality, demographics and employment experience for Type 1 diabetes mellitus

Risk factor	Crude death rate[a]	Odds ratio	Adjusted odds ratio[b]	95% Confidence interval
Women	6.6	1	1	
Men	8.1	1.2	1.3	0.6–2.62
High social class	6.1	1	1	
Low social class	7.4	1.2	1.3	0.61–2.96
Left school ≥16 yr	2.7	1	1	
Left school <16 yr	14.2	5.2	4.0	1.96–8.06[c]
None	5.3	1	1	
Registered disabled	19.5	3.7	2.9	1.44–5.61[d]
Other	5.7	1	1	
Council housing	13.4	2.4	2.6	1.35–4.91[d]
Employed	4.0	1	1	
Unemployed	13.7	3.4	3.1	1.67–5.79[e]
Unemployed <1 yr	1.5	1	1	
Unemployed 1+ yr	9.0	6.2	6.8	1.47–31.77[e]
None	5.8	1	1	
Lost job/to diabetes	15.2	2.6	2.6	1.01–6.59[c]
None	5.8	1	1	
Change job/to diabetes	13.7	2.4	2.3	0.93–5.79

[a]Rate per 1000 person years of follow-up.
[b]Adjusted for duration of diabetes.
Odds ratio significantly larger than 1 with [c]$p<0.05$, [d]$p<0.01$, [e]$p<0.001$.

Table 3. Mortality, demographics, and employment experience for Type 2 diabetes mellitus

Risk factor	Crude death rate[a]	Odds ratio	Adjusted odds ratio[b]	95% Confidence interval
Women	15.9	1	1	
Men	25.7	1.6	1.8	1.27–2.52[e]
High social class	14.5	1	1	
Low social class	24.5	1.7	2.0	1.41–2.85[e]
Left school ≥16 yr	11.4	1	1	
Left school <16 yr	25.7	2.3	42.9	1.93–4.25[e]
None	18.0	1	1	
Registered disabled	36.5	2.0	2.3	1.63–3.20[e]
Other	15.3	1	1	
Council housing	32.0	2.1	2.8	2.05–3.73[e]
Employed	13.0	1	1	
Unemployed	31.0	2.4	2.9	2.12–3.91[e]
Unemployed <1 yr	17.0	1	1	
Unemployed 1+ yr	22.4	1.3	1.5	0.85–2.69
None	20.6	1	1	
Lost job/to diabetes	32.5	1.6	2.0	1.11–3.45[c]
None	20.8	1	1	
Change job/to diabetes	25.2	1.2	1.2	0.58–2.33

[a]Rate per 1000 person years of follow-up.
[b]Adjusted for duration of diabetes.
Odds ratio significantly larger than 1 with [c] $p<0.05$, [d]$p<0.01$, [e]$p<0.001$.

related to mortality after adjusting for duration of diabetes were poor glycaemic control, for Type 2 subjects only, the presence of one or more complications and one or more hospital admissions in the previous year, for both Type 1 and Type 2 subjects.

Survival Analysis

To investigate further the survival associated with employment status and social class, a series of Kaplan-Meier plots were examined. Figure 1 shows there was a significantly different survival pattern according to employment status at baseline. Those who were unemployed had a significantly shorter survival time than those who were employed ($p<0.001$). The same pattern was observed when data were analysed by type of diabetes, confirming this finding.

A significantly ($p<0.001$) different survival time was also observed for social class, with those in the lower three social classes having a shorter survival time

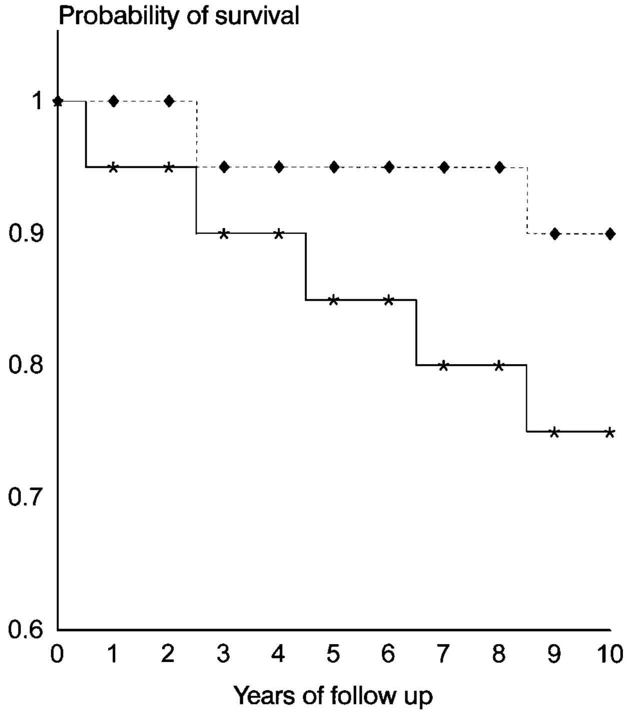

Figure 1. Probability of survival by employment status. Survival probabilities for employed (◆--------◆) and unemployed (*——*) are significantly different ($p<0.001$)

compared with those in the highest three social classes. However separate analyses by type of diabetes showed that this was only statistically significant for Type 2 subjects. Housing tenure, another indicator of social deprivation, was also examined using life table analyses and the results showed clearly that those living in council housing at the time of the survey had a significantly shorter survival time compared to owner occupiers and those in privately rented accommodation ($p<0.001$). This was true for both Type 1 and Type 2 subjects when analysed separately. Survival experience also differed according to school leaving age, with those who had left school before the age of 16 having a significantly shorter survival time than those who left school at or after the age of 16 ($p<0.01$).

Further Kaplan–Meier plots demonstrated that survival times were significantly shorter if subjects had a chronic illness, were registered disabled (both $p<0.001$), felt that they had in the past lost a job due to their diabetes ($p<0.05$) or had suffered long-term unemployment ($p<0.001$). However survival times did not differ according to subjects' actual experiences within their employment, such as having to change their job because of their diabetes, having to have time off for illness, or working shifts or evening hours. Similarly, reports of difficulties obtaining employment were not associated with shorter survival time. Survival times were significantly ($p<0.001$) shorter for those people who had problems with their job which related to illnesses other than diabetes.

Since employment status was found to be a significant predictor of mortality, the characteristics of those most likely to be unemployed and therefore at greater risk of dying were investigated in greater detail. Both Type 1 and Type 2 subjects who were unemployed were significantly more likely to be of low social class, living in rented accommodation, to have left school prior to the age of 16 and to be registered disabled (Figure 2). Both Type 1 and Type 2 subjects who were unemployed were also significantly more likely to report experiencing problems with their jobs ($p<0.001$), i.e. having lost their job due to diabetes, changed their job, had trouble getting a job, and being unemployed for longer than a year. Subjects who were unemployed at the time of the survey were significantly more likely to have one or more complications than those who were employed (Type 1 37 % vs 23 %: $p<0.001$; Type 2 46 % vs 32 %: $p<0.001$) and higher proportion of unemployed Type 1 subjects had poor glycaemic control compared with those who were employed (54 % vs 45 %: $p<0.05$).

Cox Proportional Hazards Modelling

Those factors found to be significantly associated with mortality after adjusting for duration of diabetes were used in the multivariate analysis to identify the variables most predictive of mortality (Table 4). For Type 1 subjects,

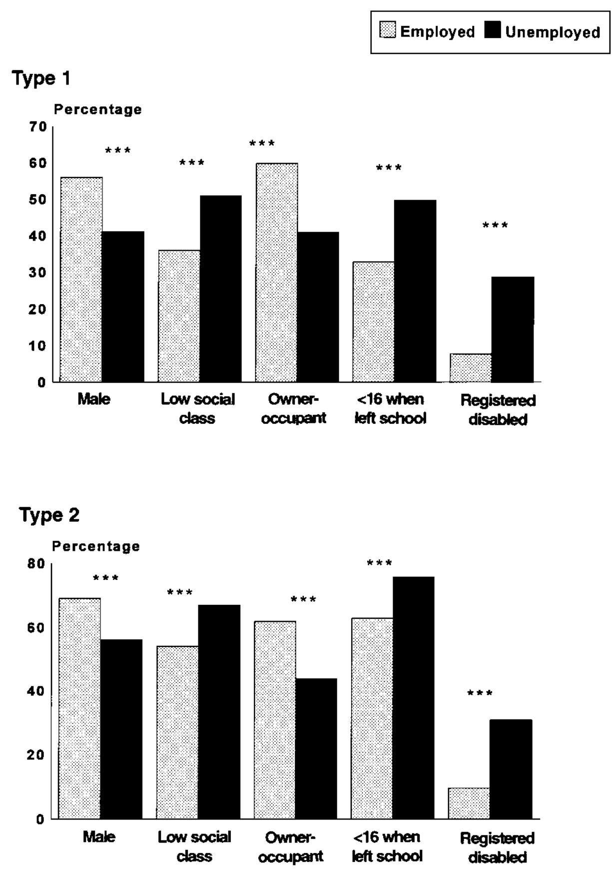

Figure 2. The association between employment status and other indicators of deprivation (*** significant difference between employed and unemployed with $p<0.001$)

Table 4. Cox Proportional Hazards Models: predictors of mortality in insulin and non-insulin dependent diabetes

Type 1				Type 2			
Significant risk factors	Standardized estimate of relative risk	Standard error	*p*-value	Significant risk factors	Standardized estimate of relative risk	Standard error	*p*-value
Model 1[a]				*Model 3*[c]			
Duration (yr)	1.71	0.01	0.000	Unemployed	2.76	0.16	0.000
Left school <16 yr	2.86	0.36	0.000	Sex, i.e. male	2.53	0.20	0.000
1+ Complication	2.39	0.31	0.001	1+ Hospital admission	2.49	0.20	0.000
Unemployed	1.92	0.31	0.015	Left school <16 yr	1.99	0.21	0.001
1+ Hospital admission	1.85	0.33	0.073	Duration (yr)	1.25	0.01	0.004
Model 2[b]				*Model 4*[d]			
Age (yr)	2.69	0.02	0.000	Unemployed	2.46	0.16	0.000
1+ Hospital admission	2.17	0.32	0.003	Sex, i.e. male	2.11	0.19	0.000
1+ Complication	2.12	0.31	0.009	1+ Hospital admission	2.39	0.19	0.000
Left school <16 yr	1.97	0.37	0.053	Age	1.37	0.01	0.000
				Left school <16 yr	1.71	0.20	0.006

Variables made available for entry into the model, [a]:For Model 1: duration of diabetes, left school before age 16, registered disabled, housing tenure, employment status, 1+ complication and 1+ hospital admission. [b]:For Model 2: as Model 1, with age made available instead of duration of diabetes. [c]: For Model 3: duration of diabetes, sex, left school before 16, registered disabled, housing tenure, employment status, 1+ complication and 1+ hospital admission. [d]: For Model 4: as Model 3 but age made available instead of duration of diabetes.

Model 1 showed that along with duration of diabetes, one or more complications, one or more hospital admissions, and school leaving age, employment status was one of the risk factors that entered the model (standardized RR 1.92, p=0.015). However, when age was forced into the model as opposed to duration of diabetes (Model 2), employment status no longer remained. Further modelling suggested that being registered disabled was also a predictor of mortality but not independently of employment status, and making glycaemic control (poor or fair) available for entry had no effect on the model.

Model 3 showed that for Type 2 subjects, employment status was a significant predictor of mortality, along with duration of diabetes, school leaving age, and one or more hospital admissions during the previous year (standardized RR=2.76, $p<0.001$). The presence of one or more complications was not a significant predictor of mortality, however gender was, with males having an increased risk of dying compared to females (standardized RR=2.53, $p<0.001$). In contrast to Type 1 subjects, when age was forced into the model rather than duration of diabetes (Model 4), employment status remained a significant predictor of mortality (standardized RR=2.46, $p<0.001$). Consistent with the analysis for Type 1, neither social class nor housing tenure were significant independent predictors of mortality in Type 2 subjects. Further modelling showed that when glycaemic control was made available for entry into the model it did in fact enter it, along with all other variables from Model 3; hence even after adjusting for diabetes control, employment status was found to be an independent risk factor for mortality.

Discussion

In this study, cross-sectional data collected by questionnaire and information obtained from hospital notes were used to investigate the relationship between measures of deprivation and subsequent mortality in adults with diabetes. At the time the information was collected (1985–87) 22 % of the men and 12 % of the women responding to the questionnaire were currently unemployed, nearly twice that of national unemployment rates at that time.[2] The initial study analysis suggested that unemployment for someone with diabetes was mainly associated with the fact that they had diabetes.[2,4] Unemployment is known to be a risk factor for mortality in the general population.[15] The excess of unemployment experienced by this diabetic population also increased their mortality risk, showing a similar relationship between unemployment and mortality in a diabetic population.

The 60 % reponse initially achieved was adequate for this analysis since the comparison of demographic and clinical characteristics, in particular the male to female ratio, age distribution, duration of diabetes, and presence of complications, between responders and non-responders showed few differences. Unemployment and social class, as far as they could be ascertained from clinic notes, were fairly similar for responders and non-responders. The study population relates to people who were currently registered with a hospital diabetic clinic and had been seen within the last year, but it is possible that this group may have had poorer control of their diabetes or were more likely to have complications. In addition the patients selected were unlikely to be living in residential or nursing homes at the time of recruitment into the study and 11 % of the mailed questionnaires were returned by the Post Office. It may therefore be inappropriate to make generalizations from this study to all people with diabetes, but it is likely that the population was representative of people attending the eight hospital clinics at this time. The accuracy of self reported data is known to be problematic.[16] In this study validation was carried out by collecting information from clinical records and comparing it with the self reported information on the questionnaire. Information obtained from both sources was comparable.

The strong link between deprivation and mortality has been well documented.[17,18] Various composite indices have been developed to measure geographical deprivation such as the Jarman index, the Townsend index, and Carstairs index.[1] Some of the components of these indices are unstable over time and change in their meaning, for example not owning a car may be as a result of choice rather than being unable to afford one. However, unemployment alone has been shown to be a good single predictor of deprivation.[15] In this study, a geographical index was not appropriate, as place of residence of subjects was not recorded and therefore unemployment was used as an indicator of deprivation. The analysis showed that even after adjusting for current health status, deprivation remained a significant predictor of mortality, in a population of people with diabetes attending selected hospital clinics in the UK. After adjusting for duration of diabetes, hospital admissions and complication status, being unemployed, male (for Type 2 subjects only), and leaving school before the age of 16 years were also significant risk factors for mortality.

Mortality has previously been used in other work as a proxy for morbidity, particularly in resource allocation,[19] since many diseases mirror the inequalities already found for mortality.[20] Previous work[21] has shown that insulin-treated patients from socially and economically deprived wards had worse diabetic control and increased morbidity compared with patients from more prosperous wards. Work carried out on deprivation and cause-specific morbidity in Somerset and Avon[19] indicated a higher differential for diabetic eye disease and suggested that this could be explained by later presentation, poor compliance to treatment or less use of screening services. The authors concluded that deprived areas should be effectively targeted if the risk of treatable blindness was to be removed. It is possible that the associations observed in this study could be explained by other

confounding factors which were not measured, for example alcohol and cigarette consumption, health behaviour and the extent of social activities and social networks.[22] These factors may all have a modifying effect on life stresses and other risk factors associated with mortality. The Office of Population Censuses and Surveys longitudinal study observed that mortality among unemployed men was higher than that observed among employed men and concluded that this occurred for reasons other than initial poor health.[15]

Deprivation has implications for both the provision of health and social care services, health promotion activities and the prevention of diabetic complications.[23] Despite advances in health care, people with diabetes have a reduced life expectancy. Although both this study and previous work have shown that health status is an important marker for those at risk, unemployment is a further important risk factor. The local bodies such as purchasers, providers, and local diabetes advisory groups, could help to reduce the effects of social deprivation on the health of people with diabetes. Such local action should include ensuring optimum standardized care for people with diabetes living in deprived areas.

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References

1. Campbell DA, Radford JMC, Burton P. Unemployment rates: an alternative to the Jarman Index. *Br Med J* 1991; **303**: 750–755.
2. Robinson N, Yateman NA, Protopapa LE, Bush L. Unemployment and diabetes. *Diabetic Med* 1989; **6**: 797–803.
3. Robinson N, Stevens LK, Protopapa LE. Education and employment for young people with diabetes. *Diabetic Med* 1993; **10**: 983–989.
4. Robinson N, Yateman NA, Protopapa LE, Bush L. Employment problems and diabetes. *Diabetic Med* 1990; **7**: 16–22.
5. Olivera EM, Dunhalde EP, Gagliardino JJ. Costs of temporary and permanent disability induced by diabetes. *Diabetes Care* 1991; **14**: 593–596.
6. Brenner MH. Mortality and the national economy: a review and the experience of England and Wales 1936–1976. *Lancet* 1979; **ii**: 586–573.
7. Department of Health and Social Security. Office of Population Censuses and Surveys and Welsh Office. *Classification of Occupations 1980*. London: HMSO, 1980.
8. Rothman JK. *Modern Epidemiology*. Boston: Little, Brown and Company, 1986.
9. Schlesselman JJ. *Case–Control Studies. Design, Conduct, Analysis*. New York: Oxford University Press, 1982.
10. Kaplan EI, Meier P. Nonparametric estimation from incomplete observations. *J Am Statist Assoc* 1958; **53**: 457–481.
11. Lee E, Desu M. A computer program for comparing k samples with right-censored data. *Computer Programs in Biomedicine* 1972; **2**: 315–321.
12. Cox DR. Regression models and life tables. *J Roy Statist Soc* 1972; **34**: 187–220.
13. Norusis MJ. *SPSSX Advanced Statistics Guide*. Chicago: McGraw-Hill, 1985.
14. Dixon WJ, Brown MB, Engelman L, Frahe JW, Hill MA, Jennrich RI, Toporek JD. *BMDP Statistical Software*. Berkeley: University of California Press, 1983.
15. Moser K, Goldblatt P, Fox J, Jones D. Unemployment and mortality: comparison of the 1971 and 1981 longitudinal study census samples. *Br Med J* 1987; **294**: 86–90.
16. Kunst AE, Geurts JGM, Vanden Berg J. International variation in socio-economic inequalities in self reported health. *J Epidemiol Community Health* 1995; **49**: 117–123.
17. Davey Smith G, Blane D, Bartley M. Explanations for socio-economic differentials in mortality: evidence from Britain and elsewhere. *Eur J Publ Health* 1994; **4**: 131–144.
18. Townsend P, Davidson N, Whitehead M. *Inequalities in Health*. Harmondsworth, Middlesex: Penguin, 1988.
19. Eachus J, Williams M, Chan P, Davey Smith G, Grainge M, Donovan J, Frankel S. Deprivation and cause specific morbidity: evidence from the Somerset and Avon survey of health. *Br Med J* 1996; **312**: 287–293.
20. Phillimore P, Beattie A, Townsend P. Widening inequality of health in Northern England, 1981–1991. *Br Med J* 1994; **308**: 1125–1128.
21. Kelly WF, Mahmood R, Turner S, Elliott K. Geographical mapping of diabetic patients from the deprived inner city shows less insulin therapy and more hyperglycaemia. *Diabetic Med* 1994; **11**: 344–348.
22. Welin L, Tibblin G, Svardsudd K, Tibblin B, Ander-Peciva S, Larsson B, Wilhelmsen L. Prospective study of social influences on mortality. *Lancet* 1985; **I**: 915–918.
23. Ward JD. Wealthy means healthy: diabetes and social deprivation. *Diabetic Med* 1994; **11**: 334–335.